* NOTICES *

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the electric field sensor and field strength measuring device which are used for measurement of the field intensity in space.
[0002]
[Description of the Prior Art]Control of the radiated electromagnetic wave generated from these electronic equipment becomes a technical problem with the spread of a computer, cellular phones, etc., and technical development which measures the electromagnetic waves in the space emitted from electronic equipment is desired. Generally, the size of the electromagnetic waves emitted from electronic equipment is expressed with field intensity. By the way, when measuring the field intensity of electromagnetic waves, the electric supply line of an antenna disturbs an electric field, or the induced electromotive force excited by the electric supply line causes an error of field intensity measurement. In order to measure a broadband, the biconical antenna and the log-periodic antenna were proposed, but the size of the antenna was large and it was not able to be used as a broadband electric field probe with minute spatial resolving power.
[0003]Then, the disorder of the electric field by an electric supply line, A broadband infinitesimal dipole antenna without excitation of induced electromotive force proposes (National Bureau of Standards Technical Note 1033:Designand Calibration of.). the NBS Isotropic Electric-Field Monitor:E.B.Larsen is carried out. This broadband infinitesimal dipole antenna is shown in drawing 9. The broadband infinitesimal dipole antenna comprises the antenna elements 401a and 401b, the diode 409, and the electric supply line 404. In order that the antenna elements 401a and 401b may realize a broadband infinitesimal dipole antenna with minute spatial resolving power, it is formed shorter than signal wave length, and the diode 409 is attached with the electroconductive glue 411 between the antenna element 401a and 401b. the output signal (less than 1W) of noncommercial communication equipment -- 10 -- when it receives apart [about m], the field intensity measured with a dipole antenna will be tens of or less mV/m. So, a highly sensitive zero bias Schottky barrier diode is used for the diode 409 for detecting an input signal. The electric supply line 404 which extends from the antenna elements 401a and 401b comprises a high resistance line with the resistivity of abbreviation 80komega/cm, in order to make small influence of the electric supply line 404 on the control and the electric field of induced electromotive force which are excited to the electric supply line 404.
[0004]If the very small dipole antenna of the form mentioned above receives the high frequency in

space, an input signal will be detected for the diode 409 attached to the antenna elements 401a and 401b, and will be changed into a direct current signal. The signal detected for the diode 409 spreads the electric supply line 404, and is sent to the amplifier of the next step. However, generally it is known that the loss of a high frequency signal when spreading an electric supply line and a resistance level is dramatically large. An output will become very small when a signal spreads the electric supply line which comprises a high resistance line like this example. When the small signal after high resistance line propagation is amplified, noise cannot become large and cannot measure exact field intensity. When a high frequency signal is amplified near the antenna immediately after reception, it will be the cause by which the amplifier itself disturbs an electric field. Then, the received high frequency signal was directly detected for the diode 409 attached to the antenna elements 401a and 401b, it changed into the direct current signal, an electric field was not disturbed by making a high resistance line spread, and little measurement of a loss is realized. However, since connection of the antenna elements 401a and 401b and the diode 409 is made with the bad conductive electroconductive glue 411, the loss of this portion surely becomes large. When the electroconductive glue 411 was used, thermoelectromotive force occurred in the joined part by the temperature change, and there was a possibility of becoming an error of the level which cannot be disregarded in electric-field-distribution measurement of tens of or less mV/m.

[0005]The diode device for submillimeter waves is indicated by JP,53-15728,A as a device which improves an above-mentioned broadband infinitesimal dipole antenna. The composition of this diode device for submillimeter waves is shown in drawing 10. While was provided on the dielectric substrate 508 and one terminal of the diode 509 for detection is bonded to the antenna element 501a by thermo-compression. The terminal of another side of the diode 509 for detection is bonded to the piece 512 of a conductor by thermo-compression, and it connects with the antenna element 501b of another side via the piece 512 of a conductor. The strip line which extended in rectangular directions is being used for the electric supply line 504 to the antenna elements 501a and 501b. The electric supply line 504 bonds the terminal of another side of the diode 509 for detection to the piece 512 of a conductor by thermo-compression, and connects it via the piece 512 of a conductor. As a result, the increase in the loss by the omission of a diode and high-resistivity-izing accompanying use of electroconductive glue can be prevented.

[0006]

[Problem(s) to be Solved by the Invention]However, there were the following issues which should be solved in the diode device for submillimeter waves as mentioned above.

1) Since device shape is right-and-left asymmetry, the capacitive coupling disequilibrium between antenna elements and in an electric supply line occurs, and it becomes a cause of a capacitive error.

2) It is what formed the antenna only in 1 shaft orientations, and it is difficult to constitute a multiaxial antenna with a biaxial antenna and an axis beyond it which measure simultaneously the signal of an electric field like vertical polarization and horizontal polarization which intersects perpendicularly and which cannot carry out things but can measure the field intensity ingredient of two dimensions also structurally simultaneously.

3) In measurement of the region cloth of an electric field with much number of times of movement of an antenna, the mechanical strength was structurally weak and the handling under measurement was difficult.

[0007]Then, the purpose of this invention is to obtain the electric field sensor and field strength

measuring device which are used for measurement of the field intensity in space without the capacitive error by the capacitive coupling disequilibrium generated since structure is unsymmetrical.
[0008]Other purposes of this invention are to obtain the electric field sensor and field strength measuring device which are used for measurement of the field intensity in the space which can measure a quadrature component simultaneously.
[0009]Other purposes of this invention are for a mechanical strength to obtain the electric field sensor and field strength measuring device which are used for measurement of the field intensity in the strong space where handling is easy.
[0010]
[Means for Solving the Problem]Such a purpose is attained by one composition of following the (1) - (4).
(1) A dipole antenna which has the two antenna elements 101a and 101b, The two metallic conductors 110a formed in the dielectric substrate 108, and the diode module 102 to which the diode 109 was connected among 110b, Have the electric supply line 104 and said diode 109 Said antenna element 101a, An electric field sensor which has arranged so that it may be located in the center between 101b, made said antenna elements 101a and 101b, said metallic conductors 110a and 110b, and said electric supply line 104 adhere mechanically, and was electrically connected and which is used for measurement of field intensity.
[0011]Since according to composition (1) the diode 109 has been arranged so that it may be located in the center between the antenna element 101a and 101b, capacitive coupling between the antenna element 101a and 101b and with the electric supply line 104 is maintained at a balance, and a capacitive error does not occur. Since the antenna elements 101a and 101b are made of not a dielectric but a metallic conductor, a mechanical strength is high, and handling under measurement is easy. There is no thermoelectromotive force generated when a temperature change is carried out compared with connection by electroconductive glue since connection of all the conductors is made by mechanical adherence, and since a loss also has little conductivity well, even field intensity of tens of or less mV/m can be measured correctly.
[0012](2) A dipole antenna which has the two antenna elements 201a and 201b, The two metallic conductors 110a formed in the dielectric substrate 108, and the diode module 202 to which the diode 109 was connected among 101b, Have the electric supply line 204 and said diode 109 Said antenna element 201a, An electric field sensor which has arranged so that it may be located in the center between 201b, made said antenna elements 201a and 201b, said metallic conductors 110a and 101b, and said electric supply line 204 adhere mechanically, electrically connected, and was attached in the plinth 203 which consists of dielectrics and which is used for measurement of field intensity.
[0013]According to composition (2), since the antenna elements 201a and 201b, the electric supply line 204, and the diode module 202 of a metallic conductor are attached in the plinth 203 of a dielectric in addition to composition (1), a mechanical strength is strong, there is no fear of damaging, even if it gets a shock like fall or a collision, and handling is easy.
[0014](3) A dipole antenna which has the two antenna elements 301a and 301b, The two metallic conductors 110a formed in the dielectric substrate 108, and the diode module 302 to which the diode 109 was connected among 110b, Have the electric supply line 304 and said diode 109 Said antenna element 301a, Arrange so that it may be located in the center between 301b, and Said antenna element 301a, The 1st electric field sensor 1 and 2nd electric field sensor 2 of each other that 301b, said metallic

conductors 110a and 110b, and said electric supply line 304 were made to adhere mechanically, and were electrically connected are formed in direction crossing at a right angle, An electric field sensor which was attached in the plinths 303a and 303b which consist of dielectrics and which is used for measurement of field intensity.

[0015]According to composition (3), since a biaxial antenna which intersects perpendicularly exists in addition to composition (2), each ingredient can be simultaneously measured about field intensity to which two-dimensional plane of polarization like vertical polarization and horizontal polarization lies at right angles.

[0016]In addition to composition (1) thru/or (3), if a diode is a zero bias Schottky barrier diode, even if it does not impress bias current, highly sensitive field intensity measurement can be performed.

[0017]It does not have influence with a plinth electric to **** measured value which uses lower dielectric constant dielectrics, such as a fluoro-resin, which is added to the composition (2) thru/or (3), and is used.

[0018](4) A field strength measuring device which is a field strength measuring device used with an electric field sensor indicated to any one of composition (1) thru/or the composition (3), and was provided with a fine signal amplifier and a measuring instrument of said signal.

[0019]According to composition (4), a field strength measuring device which has the feature of composition (1) thru/or composition (3) per measurement of field intensity can be obtained.

[0020]

[Embodiment of the Invention]Below, the details of this invention are explained based on an example. The development view and drawing 3 of a perspective view for drawing 1 to explain the example 1 of the electric field sensor used for measurement of the field intensity of this invention and drawing 2 are a top view (a) of the diode module 102, and a front view (b). The electric field sensor used for measurement of the field intensity in the space concerning this invention is provided with the following.

The dipole antenna which has the two antenna elements 101a and 101b.

The two metallic conductors 110a formed in the dielectric substrate 108, the diode module 102 to which the diode 109 was connected among 110b.

Electric supply line 104.

Have arranged the diode 109 so that it may be located in the center between the antenna element 101a and 101b, and screwed the antenna elements 101a and 101b, the metallic conductors 110a and 110b, and the electric supply line 104 on, and it was made to adhere mechanically, and has electrically connected.

[0021]Since according to said example 1 the diode 109 has been arranged so that it may be located in the center between the antenna element 101a and 101b, capacitive coupling between the antenna element 101a and 101b and with the electric supply line 104 is maintained at a balance, and a capacitive error does not occur. Since the antenna elements 101a and 101b are made of not a dielectric but a metallic conductor, a mechanical strength is high, and the handling under measurement is easy. There is no thermoelectromotive force generated when a temperature change is carried out compared with connection by electroconductive glue since connection of all the conductors is made by mechanical adherence, and since a loss also has little conductivity well, even the field intensity of tens of or less mV/m can be measured correctly.

[0022]Drawing 3 is a top view (a) of the diode module 102, and a front view (b). The diode module comprises the two metallic conductors 110a and 110b formed in the dielectric substrate 108, the two metallic conductors 110a, and the diode 109 connected among 110b. The dielectric substrate 108 vapor-

deposits metallic conductors, such as copper, to a glass epoxy board (5 mm in width, 50 mm in length, and 0.8 mm in thickness), and the metallic conductor of the center section is removed by etching 1 mm in width. Two electrodes of the diode 109 are connected by thermo compression bonding between the two metallic conductors 110a on the dielectric substrate 108, and 110b, respectively. Under the present circumstances, the diode 109 is arranged so that it may be located in the center of the dielectric substrate 108. What is necessary is to fully stick the electrode of the diode 109, and the metallic conductor on the dielectric substrate 108, and just to be able to connect, and connection of the two metallic conductors 110a and 110b on the diode 109 and the dielectric substrate 108 has thermo compression bonding and preferred soldering, in order to control generating of thermoelectromotive force.

[0023]The diode 109 used here has a desirable zero bias Schottky barrier diode. When a signal is transmitted with general transmission power, the field intensity received with an antenna is tens of mV/m or less. When detecting a signal of tens of mV/m or less for a diode, since a threshold is not exceeded unless bias current is impressed to a measurement signal, for the usual diode, sensitivity falls remarkably. Therefore, it is difficult to use the usual diode for field intensity measurement of tens of or less mV/m. In order to perform highly sensitive field intensity measurement, it is required for impression of bias current to use an unnecessary zero bias Schottky diode. A Schottky barrier diode is a diode using the potential barrier produced by contact with metal and a semiconductor, and has the features, like response time's early and standup potential is low. Even if it does not impress bias current in a Schottky barrier diode, it is a zero bias Schottky barrier diode which operates only in the input of a signal.

[0024]Next, a metal stick (75 mm in length, 5 mm in width, and 3 mm in thickness) is used for the antenna elements 101a and 101b. Although the metal stick does not need to be a square pillar and you may be a pillar, it is necessary to delete a fixed section evenly so that the antenna elements 101a and 101b and the diode module 102 may adhere enough. Resistivity used the high resistance line of 350 ohm/cm for the electric supply line 104. It fixes so that it may fully be stuck by pressure using the screw 105 made from polycarbonate, the nut 106, and the metal washers 107 with the antenna elements 101a and 101b and the diode module 102, and the electric supply line 104 constitutes a dipole antenna. Here, by sticking each part by pressure enough and making the flow of a signal good, a loss can be reduced and a minute error can be prevented. As for the construction material of the screw 105 and the nut 106, it is desirable to avoid metal so that there may be no electrical influence, and to use the product made of resin.

[0025]According to the example 1 of the electric field sensor used for measurement of the field intensity of this this invention, connection of all the conductors, There is no thermoelectromotive force generated when a temperature change is carried out compared with connection of electroconductive glue since it is carried out by thermo compression bonding and screwing, and since a loss also has little conductivity well, even the field intensity of tens of or less mV/m can be measured correctly. Since the antenna element is made of not a dielectric but a metallic conductor, a mechanical strength is high, and the handling under measurement is easy. Since the diode has been arranged so that it may be located in the center between antenna elements, capacitive coupling between antenna elements and with an electric supply line is maintained at a balance, and a capacitive error does not occur.

[0026]Next, with reference to drawing 4 and drawing 5, the example 2 of the electric field sensor used for measurement of the field intensity of this invention is explained. A perspective view for drawing 4 to explain the example 2 of the electric field sensor used for measurement of the field intensity of this invention and drawing 5 are the development view. The example 2 of the electric field sensor used for

measurement of the field intensity concerning this invention, The dipole antenna which has the two antenna elements 201a and 201b, The two metallic conductors 110a formed in the dielectric substrate 108, and the diode module 202 to which the diode 109 was connected among 110b, Have the electric supply line 204, arrange said diode 109 so that it may be located in the center between said antenna element 201a and 201b, and Said antenna elements 201a and 201b, Said metallic conductors 110a and 110b and said electric supply line 204 are made to adhere mechanically, and it electrically connects, and is attached in the plinth 203 which consists of a lower dielectric constant dielectric.

[0027]According to said example 2, since the antenna element 201, the electric supply line 204, and the diode module 202 of a metallic conductor are attached in the plinth 203 of a lower dielectric constant dielectric in addition to the example 1, a mechanical strength is strong, there is no fear of damaging, even if it gets a shock like fall or a collision, and handling is easy. Since lower dielectric constant dielectrics, such as a fluoro-resin, are used for the plinth 203 to be used, it does not have electric influence on measured value.

[0028]The thing of the same shape as said example 1 and a preparation method is used for the antenna elements 201a and 201b and the diode module 202 which are used by said example 2. The electric supply line 204 also used the thing with the same resistivity as the example 1.

[0029]The plinth 203 which fixes the antenna elements 201a and 201b and the diode module 202, A slot 5 mm in width and 5 mm in depth is excavated so that the antenna elements 201a and 201b and the diode module 202 can be inserted in a fluoro-resin (70 mm in diameter, and 15 mm in thickness). The construction material of the plinth 203 should just be lower dielectric constant dielectrics, such as a fluoro-resin.

[0030]The shape of the plinth 203 was processed into the discoid which is the most symmetrical shape in order to prevent the capacitive error generated according to the capacitive coupling disequilibrium between the antenna element 201a and 201b and in the electric supply line 204. However, the shape of the plinth 203 does not need to be disc-like, and as long as symmetry on either side is maintained, it may be a thing of a polygon like a triangle or a quadrangle.

[0031]The antenna elements 201a and 201b and the diode module 202 are inserted in the slot established in the plinth 203, and the hole penetrated to the antenna elements 201a and 201b, the diode module 202, and the plinth 203 so that a screw stop can be performed is made. A hole for the electric supply line 204 to pass in the plinth 203 is made. It is necessary to make all the holes made in the antenna elements 201a and 201b, the diode module 202, and the plinth 203 in the place which maintained symmetry on either side. By making structure symmetrical, the capacitive coupling between the antenna element 201a and 201b and in the electric supply line 204 is balancing, and a capacitive error is lost.

[0032]After inserting the electric supply line 204 in the plinth 203 and inserting through, the antenna elements 201a and 201b, and the diode module 202 in the slot of the plinth 203, It fixes so that the antenna element 201, the diode module 202 and the antenna element 201, and the electric supply line 204 may be enough stuck by pressure using the screw 205 made from polycarbonate, and the nut 206 and the metal washers 207, and a dipole antenna is constituted. By fully sticking each part by pressure, the flow of a signal can be made good and a loss can be reduced. The screw 205 and the nut 206 also need to use not metal but the thing made of resin, in order for construction material to lose electrical influence.

[0033]Next, with reference to drawing 6 and drawing 7, the example 3 of the electric field sensor used for measurement of the field intensity of this invention is explained. A perspective view for drawing 6 to

explain the example 3 of the electric field sensor used for measurement of the field intensity of this invention and drawing 7 are the development view. The field strength measuring device of this invention comprises the antenna elements 301a and 301b, the diode module 302, the plinth 303, and the electric supply line 304. The antenna elements 301a and 301b and the diode module 302 prepare 2 sets of things which performed the same shape and processing as the example 1, and they are used for them as the 1st antenna and the 2nd antenna that intersects perpendicularly. The electric supply line 304 also used the same high resistance line as the example 1. The plinth 303 excavates a slot 5 mm in width, and 3.5 mm in depth so that the antenna elements 301a and 301b and the diode module 302 can be inserted in. The 2nd slot that intersected perpendicularly to the slot which excavated the point is excavated so that the antenna element 301 which intersects perpendicularly can be inserted in the plinth 303. Let the 2nd slot be 5 mm in width, and a depth of 2.5 mm. Like the example 2, the antenna elements 301a and 301b and the diode module 302 are inserted in a slot, and the hole for letting the hole and the electric supply line 304 for screw stops pass is made. The electric supply line 304 to the plinth 303 Through and the antenna elements 301a and 301b, After inserting the diode module 302 in a slot, using the screw 305, the nut 306, and the metal washers 307 made from polycarbonate The antenna element 301a, It fixes so that 301b, the diode module 302 and the antenna element 301, and the electric supply line 304 may fully be stuck by pressure, and a dipole antenna is constituted. By fully sticking each part by pressure, the flow of a signal can be made good and a loss can be reduced.

[0034]Like the composition 2, shape of the plinth 303 was made into the discoid which is the most symmetrical shape, in order to prevent the capacitive error generated according to the capacitive coupling disequilibrium between the antenna element 301a and 301b and in the electric supply line 304. Although a polygon like [the shape of the plinth 303 does not need to be disc-like and] a quadrangle may be sufficient, it is necessary to keep the capacitive coupling disequilibrium between the antenna element 301a and 301b and in the electric supply line 304 from arising in completely symmetrical shape. The hole for carrying out a screw stop is made combining the plinth 303 so that antennas may intersect perpendicularly. It is necessary to make the hole for carrying out a screw stop in the position which maintains symmetry. Plinth 303 comrades are fixed with the screw 305 and the nuts 306 made of resin, such as polycarbonate, and a biaxial dipole antenna is constituted. As for the screw 305 and the nut 306 which fix plinth 303 comrades, it is desirable to avoid metal so that there may be no electrical influence, and to use products made of resin, such as polycarbonate.

[0035]When measuring the field intensity ingredient of three-dimensional space, it can measure by rotating 90 degrees centering on the 1st or 2nd antenna of a biaxial antenna. However, in order to simplify measurement, the field intensity ingredient of three-dimensional space can be simultaneously measured by forming the 3rd antenna in the direction which intersects perpendicularly with the 1st and 2nd antennas.

[0036]Next, with reference to drawing 8, the example of the field strength measuring device used for measurement of the field intensity of this invention is explained. Drawing 8 is a block diagram for explaining the example of the field strength measuring device used for measurement of the field intensity of this invention. The field strength measuring device used for measurement of the field intensity concerning this invention is provided with the following.

It is a field strength measuring device used with the electric field sensor indicated to any one of the example 1 thru/or the examples 3, and they are fine signal amplifiers, such as a publicly known direct amplifier.

The measuring instrument of said signal.

[0037]In the amplifier by which normal use is carried out, drift voltage will occur for a temperature change and a fine signal amplifier will cause an error of measurement. Even if the fine signal amplifier of this invention is the field intensity of tens of or less mV/m, drift voltage uses a very small signal amplifier of 5 microvolts or less so that exact measurement can be performed. The signal after amplification measures using a voltmeter, an oscilloscope, etc.
[0038]According to this example, the field strength measuring device which has the feature of the example 1 thru/or the example 3 about measurement of field intensity can be obtained.
[0039]
[Effect of the Invention]Since this invention is constituted as explained above, it does the following effects so.
(1) Since the conductor is connected by sticking by pressure or thermo compression bonding, generating does not have the thermoelectromotive force accompanying a rise in heat, and measurement of the field intensity of tens of or less mV/m can also be performed without an error. Since a conductor is connected by sticking by pressure or thermo compression bonding, conductivity is good and a loss is dramatically small compared with the time of using electroconductive glue. A mechanical strength is also strongly easy handling compared with the time of using electroconductive glue.
[0040](2) In order to use a metal stick for an antenna element, compared with the time of using a dielectric, a mechanical strength becomes strong, and handling becomes easy.
[0041](3) Since the shape of the whole device is completely symmetrical, the capacitive error by the capacitive coupling disequilibrium between antenna elements and in an electric supply line does not occur.
[0042](4) Since an antenna element and a diode module are built into the plinth of a lower dielectric constant dielectric, a mechanical strength is strong and handling is easy.
[0043](5) A biaxial infinitesimal dipole antenna can be created easily and the two-dimensional field intensity ingredient which intersects perpendicularly can be measured simultaneously.

[Translation done.]